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ABSTRACT

A study was conducted to investigate incidental learning of word meanings from context during normal reading. Subjects were 129 third grade, 85 fifth grade, and 138 seventh grade students of differing comprehension ability who first completed a vocabulary checklist containing target words and distractors, then read either expository or narrative passages from grade level textbooks. Six days after reading the selections, the students completed a multiple choice vocabulary test designed to measure their knowledge of difficult words from the passages. Small but reliable gains in knowledge of words from the passages were found at all grade and ability levels. The results suggest that getting students to read more should be an effective means for promoting vocabulary growth regardless of grade or ability. Appendices include a five page list of references and tables showing target words, and sample multiple choice questions. (FL)

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Technical Report No. 347

LEARNING WORD MEANINGS FROM CONTEXT: HOW BROADLY GENERALIZABLE?

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Abstract

This study investigated incidental learning of word meanings from context during normal reading. A total of 352 students in third, fifth, and seventh grades read either expository or narrative passages selected from grade-level textbooks, and after six days were tested on their knowledge of difficult words from the passages. Small but reliable gains in knowledge of words from the passages read were found at all grade and ability levels. Learning from written context is estimated to account for a third or more of the words acquired annually by school-age children. The results were taken to suggest that getting children to read more should be an effective means for promoting vocabulary growth regardless of grade or ability.

Learning Word Meanings From Context: How Broadly Generalizable?

Children appear to learn words at a rapid rate, adding about 3,000 words annually to their reading vocabulary between third and twelfth grade (Nagy & Herman, 1984). Only a small proportion of this growth, perhaps 200-300 words per year, could be attributed to vocabulary instruction (cf. Durkin, 1979; Jenkins & Dixon, 1983). Therefore, the default hypothesis must be that children learn most new words incidentally from context while reading and, of course, while listening (Jenkins & Dixon, 1983; Jenkins, Stein, & Wysocki, 1984; Nagy & Anderson, 1984; Nagy, Herman, & Anderson, 1985).

However, there is very little research that has satisfactorily addressed the issue of the volume of vocabulary growth that can be attributed to learning from context during reading. Much research on the use of context (e.g., Ames, 1966; Quealy, 1969; Rankin & Overholser, 1969; Sternberg & Powell, 1983; Werner & Kaplan, 1952) has looked at the task of deriving word meanings from context. That is, the reader is asked to try and figure out the meanings of highlighted words with the text in hand. What a subject can do under this special arrangement tells us very little about how likely a person is to figure out and remember the meanings of unfamiliar words during normal reading.

Another reason why the previous research fails to provide a solid basis for estimating the volume of vocabulary growth that can be attributed to learning from context is the nature of the texts. Some studies have used especially constructed texts (e.g., Jenkins, Stein, & Wysocki, 1984) in which the contexts are more informative than normal. In an extreme case, what was called "learning from context" would more accurately be labelled "learning from definitions with examples" (Gipe, 1979).

Other studies have selected target words in a way that does not permit generalization to learning from context during normal reading. For example, Ames (1966) selected target words by replacing every 50th word in text with a nonsense word. Most of the words replaced were already well-known. Thus, learning a word from context usually involved no more than matching a new label, the nonsense word, to a known concept. However, acquiring real vocabulary from context often involves learning new concepts as well as new labels. Thus, any experiment substituting nonsense words for real words, or using unfamiliar synonyms for familiar words, underestimates the difficulty of learning from context.

Still other studies have looked only at words that subjects had no prior knowledge of, but then tested for full knowledge of the words (e.g., Baldwin & Schatz, 1984). Little vocabulary growth is seen under these conditions. Why? We hypothesize (see also Deighton, 1959) that learning from context typically takes

place in small increments, so that any one encounter with a word usually results in only a small gain in knowledge of that word. If a subject starts with no prior knowledge of a word, a single exposure to the word in context is not likely to produce a level of knowledge sufficient for the subject to demonstrate knowledge of the word on any but the easiest of tests.

Previous research, then, furnishes only a shaky basis for determining the amount of learning from context that actually takes place during normal reading. This is not meant as a criticism of this research, for in general it was not conducted with the goal of assessing the contribution of incidental learning from context to children's overall vocabulary growth. Nonetheless, because this is an important matter, people go ahead and draw conclusions from the research anyway, despite its limitations considering the purpose. It is apparent that there is a need for research that provides a stronger foundation for conclusions about the absolute amount of learning from context that occurs during reading.

Nagy, Herman, and Anderson (1985) attempted to measure learning from context in a way that would have implications for vocabulary learning during normal reading. Eighth-grade students of average or above-average ability read one of two texts taken from grade level school books, one an exposition, and the other a narrative. Subjects were told that they would be tested on what they had read, but no further information about the purpose of

the experiment was given. After a fifteen minute interval, subjects were tested on their knowledge of difficult words selected from both texts, first in an interview, and then through a multiple-choice test.

Both the interview and multiple-choice test were designed to measure degrees of word knowledge. In the interview, a subject got credit for full word knowledge by providing a complete, adult-like definition, but, failing that, got credit for partial knowledge by furnishing an incomplete definition or, at the lowest level, for mentioning any distinction conveyed by the word. In the multiple-choice test, there were three levels of difficulty for each word. Questions at the lowest level could be answered correctly on the basis of minimal word knowledge, for example, knowledge of the part of speech, or the general semantic category. At the most difficult multiple-choice level, a correct answer required distinguishing between the meaning of the target word and the meanings of closely related words.

Significant learning from context was found with both measures at all levels of difficulty. Although slightly more learning from context appeared at the lower levels of difficulty, this tendency was not significant. Thus, the type of measure of word knowledge used--whether interview or multiple-choice test, low or high in difficulty—does not seem to make a large difference in the amount of learning from context that is detected. Learning from context was not confined to picking up

general information about words; some subjects gleaned enough knowledge of some words to provide complete definitions. However, we hypothesize that this happened only when the words were already partially known.

The absolute amount of learning from context observed by Nagy, Herman, and Anderson (1985) was rather small. The chance of a subject learning a word was between 0.15 and 0.22 for the multiple-choice test, depending on the level of question difficulty. Nonetheless, as we shall explain in the last section of this paper, even a small probability of learning a word from context can result in large scale vocabulary growth, if there is a sufficient volume of wide reading.

While the Nagy, Herman, and Anderson (1985) study readdressed some of the shortcomings of earlier research, it, too, had undesirable features which may have led to a misestimation of the role of learning from written context in a child's annual vocabulary growth. First, there was only a fifteen minute interval between reading and testing. Some of the gains observed after this short interval may have reflected temporary memory for the story rather than genuine vocabulary growth. Second, there was a restricted range of age and ability among the subjects. All the subjects in the study were able, eighth-grade readers. Younger or less able readers might learn fewer words from context. Finally, only two texts were employed,

too few to warrant conclusions about young people's reading material in general.

The present study was designed to deal with these three deficiences, and determine what amount of learning from context would be found when subjects with a wider range of age and ability read a greater variety of texts and are tested for gains in word knowledge after an extended interval.

Method

Subjects

Subjects were 418 children attending suburban midwestern schools: 157 in third grade, 100 in fifth grade, and 161 in seventh grade. Only subjects who participated in all three experimental sessions were included in the data analyses, leaving 129 subjects in third grade, 85 in fifth grade, and 138 in seventh grade. Reading ability was represented by percentiles from the Vocabulary and Reading Comprehension subscales of the SRA Achievement Series (1978) taken from school files. For 50 subjects for whom standardized test scores were not available, values were estimated (via a linear regression equation) from their performance on the general vocabulary component of the vocabulary checklist pretest administered in the study (see Materials). At each grade, a range of comprehension ability was represented (third grade $\underline{M}$ = 63, range 15 to 90; fifth grade $\underline{M}$ = 66, range 18 to 98; seventh grade $\underline{M}$ = 66, range 11 to 97).

Subjects were assigned randomly to read either the expository or narrative texts selected for their grade (see Materials), and to one of the versions of the vocabulary checklist pretest and multiple-choice posttest.

Materials

Texts. All texts were taken from grade-level books. Both easier and harder texts were chosen for each grade so that floor and ceiling effects would be avoided. "Easy" was based on a broad judgment of how familiar the topic was for a particular age group. For example, the third grade story about a mother mouse was judged to be more familiar than a story about an African farmer visiting a big city. Tables 1, 2, and 3 list titles, numbers of words, and target words for the texts.

Insert Tables 1, 2 and 3 about here.

Four texts were chosen for the third grade. "Bear Mouse in Winter" (Freschet, 1984) in Ten Times Round features a mother mouse looking for food during winter. She is almost caught by an owl and a bobcat. "The Great Kapnu" (Wilson, 1979) in A Place Called Morning describes an African farmer's first visit to Accra, Ghana. Of these two narratives, the mouse story was judged to be easier than the farmer story.

Finding appropriate third-grade expositions proved to be challenging, as most social studies and science books we looked

at did not contain passages that were long enough. One science book did, Exploring Science (Blecha, Gega, & Green, 1982). From this book, an easier and a harder exposition was chosen using the familiarity criteria. The easier text, "Water is Necessary" (pp. 34-38), details functions of water in sweat, saliva, washing, cooking, and making electricity. "On the Moon" (pp. 21-24), the harder, less familiar text, deals with more sophisticated concepts, conditions on the moon's surface.

Four texts were identified for fifth grade. The easier narrative, "The Railroad Ghost" (Pringle, 1974) in Images is a mystery: A mysterious flagman stops a train just short of a washed out bridge. The harder narrative, "State Lore" in But Life is Calling You (Leach, 1971), contains tall tales and legends from several states. Most of the tales are set in Colonial times. The easier exposition, "Vanishing Giants" in Patterns (Eller & Hester, 1980) describes how overhunting has left few whales. The less familiar, "A Brazilian Plantation" in America Past and Present (Schreiber, Stepien, Patrick, Remey, Gay, & Hoffman, 1983), served as the harder exposition.

Finally, four seventh-grade texts were chosen. A narration about a man's attempt to keep two burros in a pen, "My Battle with the Burros" (Oboler, 1968) in New Reading Skill Builder, was the easier text. For the harder narrative, a science fiction tale, "Security Check" (Clarke, 1974) in Serendipity was chosen. From the seventh-grade health book, Choosing Good Health (Merki,

1983) two adjacent sections were chosen, "The Respiratory System" and "The Circulatory System" (pp. 89-92). These sections served as the easier exposition. "The Iceberg Cometh" (pp. 80-83) in Serendipity (Durr, Pescosolido, & Poetter, 1974), the harder exposition, describes how icebergs could be towed from the South Pole to supply California with fresh water.

All texts were typed verbatim on plain, white paper, except for "Security Check." Two introductory paragraphs were deleted from this text in order to make its length comparable to the length of the other seventh-grade narrative. The third-grade texts were printed in larger type than the fifth and seventh grade texts.

Target words. The most difficult words from each text were selected as target words. All words except common function words (e.g., the, which, into) were reprinted in alphabetized columns by text and by grade level. Teachers with experience at each grade were given the lists and asked to circle any word they believed that an average student in that grade would find difficult to define. Words identified by all seven raters were included among the target words. For some of the easier, shorter texts, words identified by five or six of the raters were included to bring the number of target words up to a minimum of 15.

We believe that the complete set of words constitutes a representative sample of the difficult words that children

encounter during reading. As can be seen from Tables 1, 2 and 3, a variety of word types was represented; for example, proper nouns (Ghana, Catholicism), verbs (slunk, riffle), nouns, adjectives, a conjunction (notwithstanding), two-word compounds (warm-blooded, carbon dioxide), and words with affixes (reassure, inaccessible).

Another indication of the representativeness of the words is that, unlike the words examined in most other studies, some were already partially known by many of the subjects. To prevent variation among subjects in prior knowledge of the words from diminishing the sensitivity of the experiment, it was designed so that learning from context was a within-subject factor in which subjects "served as their own controls." Also, a target word pretest in the form of a checklist task (see below) served as the basis for statistical control of individual patterns of variation in prior knowledge of the words.

Checklist vocabulary test. For a measure of vocabulary knowledge prior to the subjects' reading of the experimental texts, a checklist test was developed using guidelines suggested by Anderson and Freebody (1983).

The checklist test was chosen for two reasons. Most importantly, it gives the student no information or feedback about the meanings of the words tested. Secondly, it is sensitive to partial word knowledge. Subjects tend to mark a word as known if they have even a partial grasp of its meaning

(Anderson & Freebody, 1983); so if a subject fails to mark a word as known, one can be fairly confident that the subject knows very little about that word. A weakness of this instrument is that it is not suitable for use as both a pre- and posttest.

Three, grade-level checklist vocabulary tests were constructed with 191 items for third grade, 194 items for fifth grade, and 203 items for seventh grade in the following categories:

1. Target words. Third grade, 66; fifth grade, 69; seventh grade, 78.

2. Twenty-five decoding distractors. These are items which would be marked as known only on the basis of a decoding error (e.g., cobe, robbit).

3. Twenty-five pseudoderivatives. These are not exisiting words of English but are constructed from existing English stems and affixes (e.g., bonely, earthous).

4. Twenty-five nonwords. Items in this category have English-like spellings (e.g., felinder, shumet, sprale), but they are not existing English words. Furthermore, they do not belong to either of the two preceding categories. That is, they are not constructed from real English stems and suffixes, nor could they be mistaken for real words if some plausible error were made in decoding. Only nonwords in the last category were used in computing a correction factor for a subject.

5. Fifty general vocabulary items. These items, chosen from Dupuy's (1974) list of 123 general vocabulary words, represent a range of word difficulty. Every other easy word was chosen from Dupuy's list, then every third hard word (to avoid overloading the test with hard words). Some of the easier words at the beginning of Dupuy's list were likely to be known by less able third grade readers (e.g., shore, poor, quit). On the other hand, the most difficult words were unlikely to be known by most adults (e.g., pomander, soredium, pyrope). Such a range of words precludes a performance floor or ceiling.

Three versions of the checklist vocabulary test were constructed for each grade. The versions were identical except for the order in which the items were presented.

Multiple-choice test. A multiple-choice test was constructed for each grade that contained all the target words for that grade. Each multiple-choice question contained the correct answer, three distractors, and a "don't know" option. Position of the correct answer was assigned in quasi-random fashion with correct answers occurring with equal frequency in the first four positions. The "don't know" option was always in the last (fifth) position. Examples of questions for the three grades are given in Table 4.

Insert Table 4 about here.

Multiple-choice questions were constructed in the following way: First, a concise definition was chosen to serve as the correct answer. For example, from the fifth-grade test, the definition for ridicule was "to laugh at, make fun of." For outskirts in the third grade test, it was "the area away from the main part of a city."

Second, three distractors were created for each question, consisting of concise definitions of words semantically similar to the target word and of the same part of speech. No distractors were meant to be tricky or extremely difficult. In Table 4, for example, one can see that the distractors for slink in the third-grade test were all definitions of verbs characterizing kinds of motion. The distractors for headlamp in the fifth-grade test were all definitions of nouns representing types of man-made lights. Finally, in the seventh-grade test, the distractors for indignant represented definitions of adjectives and all had to do with moods or emotions.

With two exceptions, the distractors for all target words represented definitions of real words to insure that legitimate, possible meanings were used. However, for fishery in the fifth-grade test and earstroking in the seventh-grade test, it was impossible to find definitions of existing words that were judged to be at the same level of difficulty as other questions in the test. For these questions, plausible distractors were invented. Ear-stroking, for instance, had these phrases as distractors:

"soft and pleasant sounding," "a style of rowing used in boat races," "pulling someone's ears as punishment."

For each grade, three versions of the test were prepared in which the questions were arranged in different orders.

Procedures

Two weeks before the main part of the study, the grade appropriate checklist test was administered to all participating classes by the researchers. Care was taken that adjacent students received different test versions. A researcher read the direction page to the class, and then students completed the test on their own. All students finished within 15 minutes.

The main study consisted of two sessions one week apart. Classroom teachers were specifically instructed not to tell their students about the second session.

In the first session, students were asked to read two narratives or two expositions. Booklets were arranged so that the easier of the two selections appeared first to minimize frustration. Students seated adjacent to one another received selections from different genre. Before reading, students were told that we were interested in finding out how children learn from reading. No mention of vocabulary was made. Then students were asked to read the first story. No help was given to students while reading. When done, they were told to sit quietly or to reread until all other students had finished reading the first story. Next students read the second story.

After all had finished, instructions were read aloud for the six questions assessing a student's familiarity, interest, and ease of reading of the two stories (see Table 5 for sample questions). Upon finishing these questions, students were done with the first session. We hoped they would feel that the questions concluded the study.

Insert Table 5 about here.

One week later, the researchers returned for a surprise visit. The multiple-choice vocabulary test was passed out, alternating test versions between students. A researcher read aloud the test directions, which explained how to do the test and provided students with two examples. One example illustrated when to use the "Don't know" option. Students worked at their own pace. Third- and fifth-grade students circled answers directly in the test booklet. This was done to minimize the younger students' marking answers in the wrong place. Seventh-grade students were provided with answer sheets.

Design and Analysis

The data were analyzed using hierarchical regression procedures in the manner of mixed between-subjects and within-subjects analysis of variance. Between-subject factors were Comprehension Percentile (based on national norms provided by the test publisher), Grade (3, 5, or 7), and Texts Read (narratives

or expositions). Within-subject factors were Difficulty (easier or harder text), Genre (narrative or exposition), Prior Word Knowledge (proportion of target words from a text checked as known on the pretest), and Learning from Context (word encountered in context versus word not encountered). Difficulty and Genre were nested within grade.

In the phase of the analysis in which the total variance was partitioned, within-subjects factors were entered first, then interactions among within-subjects factors, between factors next, followed by interactions of within-subjects and between-subjects factors. Learning from Context and the interactions of other factors with Learning from Context were entered last in order to discount any possible confounds. Interactions were coded for step-wise inclusion because little was known about which ones were likely to be important. Analyses of residuals revealed no abnormalities in the data; $\underline{r} = 0$ between residuals and estimated values.

The $\underline{F}$ ratio for each factor was based on the increment in $\underline{R}^2$ at the point where the factor entered the analysis. Between-subjects factors were tested against between-subjects error variance and within-subjects factors were tested against within-subjects error variance. In each case, the error variance was based on the final residual after every factor had been entered in the analysis. The comparisonwise alpha level was set at .01 to keep the experimentwise error rate within reasonable bounds.

In the analysis that will be reported in detail, the data were aggregated by subject. That is to say, the unit of analysis was the individual subject's performance. In a subsidiary analysis, the data were aggregated by word and, therefore, the unit of analysis was the word. This analysis was comparable to the one in which the subject was the unit of analysis.

Results

Table 6 summarizes the regression analysis in which the subject was the unit of analysis. The dependent variable was percentage right on the posttest, after a correction for guessing. The table presents the final, reduced model from which nonsignificant interactions have been deleted. Each regression coefficient indicates the percentage increase or decrease in posttest score associated with a one unit change in the variable listed in the lefthand column. The figures in the column captioned Between are based on the analysis that included only between-subject variables. The figures in the column headed Total are based on the analysis that included all of the variables. The column labeled Percent of Variance gives estimates of the magnitude of the effect of each variable derived from the increment in $\underline{R}^2$ at the point where the variable entered the analysis. In the rows labeled Constant/Residual, the first number is the constant (i.e., the intercept) and the second number is the residual (i.e., the unexplained, or error, variance).

Insert Table 6 about here.

The principal finding of the study was the significant effect of Learning from Context. The effect was small, however, as in other recent studies (Nagy, Herman, & Anderson, 1985; Jenkins, Stein, and Wysocki, 1984), accounting for only .8% of the within-subjects variance. Expressing the result in absolute terms, other things being equal, those who had read a text knew 3.3% more of the difficult words it contained than those who had not read the text.

Briefly reviewing the other effects, posttest scores were higher for texts judged to be easy than texts judged to be hard, higher for narratives than expositions, and higher for words subjects indicated that they knew on the pretest. The interactions that were observed reflect the ease or difficulty of the specific texts that happened to be selected, and, therefore, are of no general theoretical or practical interest.

Just one finding from the analysis in which the results were aggregated by the word will be reported: The effect of Learning from Context was significant again, $F(1,207) = 24.16$, $p < .01$, % Var = 9.45, B = 1.62.

Treating both subjects and words as random variables, the minimum quasi-F ratio for Learning from Context is significant, min $F'(1,1430) = 20.4$, $p < .01$. This provides a warrant for

simultaneously generalizing to the entire population of middle grade children and the entire universe of difficult words in texts for children in this age range. The caveat, of course, is that while the children and the words can be regarded as representative, neither was actually sampled randomly.

Discussion

Our results demonstrate beyond reasonable doubt that incidental learning of word meanings does take place during normal reading. While educators have long believed that learning from written context is a major source of vocabulary growth, the results are noteworthy considering the poor showing that learning from context has made in other empirical studies. Jenkins, Stein, & Wysocki (1984), for instance, failed to find significant learning from context from two exposures to target words in specially constructed, rich contexts.

The present study was designed in such a way that the results can be legitimately regarded as showing that learning from context is a broadly generalizable phenomenon. A range of texts and word types was included. The texts were taken from ordinary grade level books. Most of the target words (149 out of 212, or 70.3%) occurred only once in a text. The target words were not highlighted in any way. The students ranged widely in age and reading ability. They did not expect to be tested words from the texts. There was a lengthy interval between reading and testing. All in all, the experiment provides a good simulation

of children's incidental learning of words from context during normal reading, and provides a sturdy foundation for the conclusion that the effect of learning from context is broadly generalizable.

The absolute amount of learning from context found in this study was small. The overall probability of learning a word was 0.05, about one third as large as the probability found with a comparable multiple-choice test in our previous study (Nagy, Herman, & Anderson, 1985). In that study, the multiple-choice tests were administered within fifteen minutes of reading the experimental texts, whereas in the current study, the multiple-choice test was given six days later; so such a decrease is not surprising. Any further decrease that would occur over an even longer interval between reading and testing probably would be slight.

Though the probability of learning a word from context may seem too small to be of any practical value, one must consider the volume of reading that children do to properly assess the contribution of learning from context while reading to long-term vocabulary growth. Annual vocabulary growth attributable to learning from written context is the product of the probability of learning an unknown word from context and the number of unknown words encountered per year while reading. The number of unknown words encountered per year can be estimated by

multiplying the annual volume of reading by the proportion of unfamiliar words in text.

How much does the average child read? According to Fielding, Wilson, and Anderson (in press), the median fifth-grade student reads about 400,000 words per year from books outside of school. If a student read 15 minutes a day in school (see Allington, 1983; Dishaw, 1977; Leinhardt, Zigmond, & Cooley, 1981) at 200 words per minute, 200 days per year, 600,000 words of text would be covered. Thus, a rough estimate of the the total annual volume of reading for a typical fifth grade student is a million words per year; many children will easily double this figure.

How many unfamiliar words will a child encounter per year while reading? Not taking repetition into account, the average child reading a million words per year probably encounters 20,000-40,000 unfamiliar words. Reanalysis of data collected by Anderson and Freebody (1983), using information on the frequency of words in children's reading material from Carroll, Davies, and Richman (1971), indicates that the number of <u>different</u> unknown words encountered per year is roughly 16,000-24,000.

How many words per year do children learn from context while reading, then? Given a 0.05 chance of learning a word from context, the average child reading a million words per year would encounter about 16,000-24,000 unknown words and would learn

approximately 800-1,200 of them well enough to pass fairly discriminating multiple choice items.

These numbers are at the low end of the range that we have previously estimated (Nagy, Herman, & Anderson, 1985; see also Nagy & Anderson, 1984), because of the lower estimate of the probability of learning a word from context and a more conservative estimate of the number of unkown words encountered during reading. Yet, the figures suggest that incidental learning from written context represents about a third of a child's annual vocabulary growth, an increase in absolute vocabulary size that has not even been approached by any program of direct vocabulary instruction.

One of the most surprising results of the present study was the lack of a significant effect of ability on learning from context. This result was not expected; the study was expressly designed to investigate the hypothesized influence of ability. In each grade, a range of ability levels was represented. Each subject received both an easier and harder grade-appropriate text to avoid performance floors and ceilings. The means and standard deviations did not suggest any apparent floor or ceiling, nor did a scatterplot of posttest scores as a function of ability.

A number of different ability measures were explored for possible interactions with learning from context: Standardized reading comprehension and vocabulary scores, expressed both as percentiles within grades and as absolute scores across grades; a

vocabulary score from a general vocabulary test incorporated in the checklist vocabulary pretest; measures of decoding skill and facility with morphology based on the ckecklist test; and ability as reflected in the subjects' overall performance on the multiple choice posttest. In no case did the interaction of learning from context with an ability measure even approach statistical significance.

There are two studies that have investigated incidental learning of word meanings from natural texts, and hence are directly comparable with the research reported here: Nagy, Herman, and Anderson (1985), and Herman (1984). In the Nagy et al. study, there was a nonsignificant trend for able readers to learn more words from context than less able readers. In this case, the lack of statistical significance may be attributable to a restricted range of ability; all subjects in the study were average or above average readers. Herman (1984), on the other hand, who studied eighth graders varying widely in ability, found the expected significant effect of ability on learning from context.

The range of ability among subjects cannot be the whole story, however. The range was even greater in the present study than in Herman's study, but the beta weight for the interaction of learning from context with ability was over twice as large in Herman's study as in the present one.

We believe that the erratic relationship between reading ability and learning from context is best understood in terms of a theory of the acquisition of word knowledge. According to the theory, words are known to different degrees along a continuum of levels of word knowledge. We assume that when unknown or partially known words are encountered in a text, there is usually a small increment in knowledge. However, for any given reader, only an occasional word will move across the threshold of knowledge required to pass a test item on that word. Usually this will happen just in case a word was previously known to a degree a little short of that which would enable the reader to answer the question correctly.

Because the words selected as targets in the present study represent a range of difficulty and are associated with a range of levels of prior knowledge, for every reader a few of the words are likely to be at the threshold point where one exposure in context will result in a measurable increment on the multiple-choice posttest. While the location of the threshold may differ according to ability, there is no reason why the number of target words at this threshold should be different for high and low ability students. Provided that the target words represent a wide enough range of difficulty and prior knowledge, students at every level of ability should have roughly equal opportunities to make gains in word knowledge. The limiting cases are the high end of the ability range, the student who already knows all the

words, and at the other end, the student for whom the text is incomprehensible so that no learning is possible.

We hypothesize, then, that the wider the range of difficulty of the target words, the smaller the effect of ability on incidental learning from context. This provides a possible explanation for the difference between the results of this study and those of Herman (1984). Most of the 46 target words in Herman's study were conceptually difficult (e.g., aorta, meander). In the present study, on the other hand, there were a total of 212 target words, approximately 70 at each grade level, representing a wide range of difficulty and prior knowledge.

Jenkins, Stein, and Wysocki (1984) measured incidental learning from context, but with specially constructed contexts which were designed to be rich, although as natural as possible. They also found a significant effect of ability on learning from context. Their target words were chosen as words not likely to be even partially known by most of their fifth grade subjects; thus in their study, as in Herman's, the target words covered a narrower range of difficulty and degrees of prior knowledge than in the present study.

Studies that have looked at the effects of reading ability on students' success at deriving word meanings from context have consistently found a large ability influence (Daneman & Green, in press; McKeown, 1985; Quealy, 1969; Rankin & Overholser, 1969; Sternberg & Powell, 1983). However, studies in deriving word

meanings from context measure subjects' ability to figure out the meaning of an unfamiliar word, given explicit instructions to do so, and almost always with the text available. The present study, on the other hand, measured the gain in vocabulary knowledge retained 6 days after reading, and subjects had been given no instructions about learning vocabulary.

Most of the studies in deriving word meanings from context differ in another important respect from the present research on incidental learning of word meanings from context. In every study of deriving word meanings, except for Sternberg and Powell (1983) and Daneman and Green (in press), nonsense words or blanks were substituted for real words. In the Sternberg and Powell study, while low-frequency, real words were used, many, judging from the examples given, were simply uncommon synonyms for relatively familiar words. In the present study, on the other hand, only 23% of the target words were judged by raters as having a more frequent synonym. Therefore, for the experiments on deriving word meanings from context, the task has been finding a known word that fits into a given context. Success on this task will be highly dependent on the reader's existing vocabulary knowledge, which in turn is highly correlated with standardized measures of comprehension ability (Anderson & Freebody, 1981).

In the Daneman and Green study, the meanings of the target words were specifically chosen to have unusual, difficult meanings. This avoids the weakness of the other studies, which

reduce learning from context to finding synonyms. However, according to our model of learning from context, the restriction in the range of difficulty of target words still leads to an inflated idea about the association between ability and learning from context.

An Educational Policy Implication

Researchers have often emphasized--in our judgement, overemphasized--the effects of age and ability on learning from context. Werner and Kaplan (1952) concluded that in general children younger than ten years could not make effective use of implicit contextual information. McKeown (1985) likewise drew pessimistic conclusions about the effectiveness of incidental learning from context for low-ability children: "The implication is that having a correct definition, or exposure to multiple contexts, is not enough--at least for low-ability children--to allow a word to become a useful part of one's vocabulary repertoire" (p. 495). Of course, these conclusions are myopic. Logic forces the conclusion that incidental learning from context must be a major factor in vocabulary acquisition. How else could the children of the world, less able as well as able, unschooled as well as schooled, learn their languages? Words may be taught or explained by the dozens, perhaps in some schools by the hundreds; but children are acquiring words by the thousands, very often apart from any explicit vocabulary instruction.

Considering that much if not most of children's vocabulary is acquired incidentally from context, and considering the strong relationship that holds between vocabulary knowledge and general verbal ability, it is tempting to conclude that vocabulary size is a direct reflection of a child's ability to learn from context (Jensen, 1980; Sternberg & Powell, 1983). Given equal exposure to the language, so the argument goes, the child who is better at learning from context will acquire a larger vocabulary.

With some benefit from hindsight, it now appears to us that this argument rests on two weak assumptions. The first is that there is a strong relationship between ability and learning from context. If we are correct, studies which restrict the range of difficulty of target words, either by using only difficult words, or by using nonsense words, blanks, or low-frequency synonyms for familiar words, give an exaggerated impression of the role of ability in learning words from context during normal reading. Every previous study known to us has suffered from one or more of these faults. Higher ability students are probably somewhat better at making inferences about unknown words encountered in context--especially in experimental situations--just as they will perform better on almost any other academic task. However, our results suggest that given natural text and a natural range of unknown and partially known words, the amount of vocabulary growth that occurs during reading is not strongly related to ability.

The second weak assumption is that children have equal exposure to the language. Children at different ability levels do not have equal volume of experience with language. In fact, we hypothesize that the relationship between ability and vocabulary size is to a large extent mediated by volume of language experience. In school, reading lessons are often conducted in such a way that high ability students end up doing much more reading of connected text for meaning than do lower ability students (cf. Hiebert, 1983; Allington, 1984). Outside of school, there appear to be order of magnitude differences in the amount of time children spend reading (Fielding, Wilson, & Anderson, in press; Greany, 1980). It is largely the higher ability students who read a substantial amount outside of school.

Which has the bigger influence on vocabulary growth--ability to glean information about words from written context, or volume of reading? Depending on the answer, educational policy ought to take different directions. Trying to increase children's ability to make inferences about word meanings as they read may have some value; but the implication from the research summarized in this paper is that it is at least as important, and probably more important, to <u>try to increase the amount of reading children do.</u>

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Table 1

Summary of Passages, Total Words and Target Words for Third Grade

Passage	Total Words in story	Target Words
Narrative:		
"Bear Mouse"[a]	620	bill, bound, cardinal, crouch, desperate, exhausted, forepaw, heave, huddle, pounce, scent, slightest, slunk, snarl, storehouse, tuft, wedge
"Great Minu"	566	Accra, bystander, fashionably, Ghana, harbor, impressive, inquire, latch, mahogany, mourner, outskirts, procession, puzzled, thatched, trudge, wail, yam
Expository:		
"Water is Necessary"[a]	498	electricity, evaporate, fact, important, liquid, necessary, nonliving, radio, raise, saliva, stomach, swallow, sweat, vapor, weight
"On the Moon"	642	astronaut, basalt, billion, breccia, condition, crater, force, geologist, gravity, kilometer, lava, meteorite, natural, plain, soil, surface, telescope

[a]The "easier" text

Table 2

Summary of Passages, Total Words and Target Words for Fifth Grade

Passage	Total Words	Target Words
Narrative:		
"Railroad Ghost"[a]	588	absolutely, cloak, convince, dense, desperate, flagged, frantically, gasp, headlamp, particular, phantom, plunge, resemble, scant, topple, triumphantly, Victoria
"State Lore"	704	anecdote, austere, coverlet, destination, earshot, emaciated, exorbitant, jaunty, lore, maniac, ragamuffin, ridicule, taciturn, unanimous, unsteered, wares
Expository:		
"Vanishing Giants"[a]	629	blubber, cruise, extinction, fishery, gear, hardy, harpoon, overhunting, prey, profitable, refuse, regulations, sonar, species, vanishing, warm-blooded, whaler
"Brazilian Plantation"	715	alternate, Amazon, Brasilia, Brazilian, cacao, Catholicism, descent, feud, homespun, mestizo, plateau, Portuguese, prosper, Rio de Janeiro, rotate, tract, Uruguay, ward off

[a]The "easier" text

Table 3

Summary of Passages, Total Words and Target Words for Seventh Grade

Passage	Total Words	Target Words
Narrative:		
"My Battle with the Burros"[a]	1170	axle, barbed, bray, dignified, dismay, earstroking, expel, foreleg, fuse, gaze, infancy, operatic, pruning, pursuit, quarters, reassure, romp, truce
"Security Check"	1490	access, authenticity, Bavarian, credentials, decor, deteriorate, disconcerting, disintegrator, ensure, gullet, indignant, legion, naive, notwithstanding, portfolio, prototype, proton, realism, recital, render, riffle, sheaf, tedious, Victorian
Expository:		
"Respiratory System" "Circulatory System"[a]	661	alveoli, aorta, artery, atrium, bronchi, capillary, carbon dioxide, cilia, circultory, filter, membrane, mucus, nutrient, oxidation, respiratory, sacs, trachea, valve, ventricle
"The Iceberg Cometh"	672	analysis, appreciably, aqueduct, auxiliary, blight, conveyor, craggy, current, devise, exert, finance, growler, inaccessible, lasso, latitude, literally, scheme

[a]The "easier" text

Table 4

Examples of Multiple-choice Items for Third, Fifth and Seventh Grades

	Third Grade
slink	a) to move in a quiet, sneaky way b) to walk in a proud, boastful way c) to become perfectly still d) to shiver or shake e) don't know
	Fifth Grade
headlamp	a) a tower with a bright light to warn and guide ships b) a small electric light powered by batteries c) a light on the front of a train, car, or truck d) a set of electric lights used to control traffic e) don't know
	Seventh Grade
indignant	a) very sure; confident b) giving in easily; not resisting c) full of pep and energy d) angry because something seems unfair e) don't know

Table 5

Examples of story questions

How much have you read about this subject before?

a) a whole lot

b) some

c) very little

d) nothing at all

How interesting was this story to you?

a) very interesting

b) a little bit interesting

c) a little boring

d) very boring

How many words were there in the story that you didn't know?

a) so many it made the story hard to understand

b) some words I didn't know

c) one or two words I didn't know

d) no words I didn't know

Table 6

Multiple Regression Analysis of Multiple Choice Posttest Data

Variable	Regression Coefficients Between	Total	Percent of Variance	F
Between Subjects				
Comprehension Percentile	0.4	0.2	30.8	155.9*
Grade[a]	0.8	0.3	0.9	4.6
Texts Student Read[b]	1.0	0.0	0.4	2.1
Constant/Residual	7.9		67.9	
Within Subject				
Text Difficulty[c]		-10.5	45.4	1947.3*
Genre[b]		-24.1	13.3	569.4*
Prior Target Word Knowledge		22.3	1.7	73.7*
Text Difficulty x Genre		9.6	1.1	48.8*
Text Difficulty x Prior Target Word Knowledge		-8.5	1.1	48.1*
Genre x Prior Target Word Knowledge		-6.0	0.3	11.0*
Genre x Grade		6.1	1.7	73.1*
Text Difficulty x Comprehension Percentile		-0.1	0.2	9.3*
Text Difficulty x Genre x Grade		-3.1	2.1	88.5*
Learning from Context[d]		1.7	0.8	35.5*
Constant/Residual		11.4	32.0	

*$p < .01$
[a]Coded 3,5,7
[b]Coded +1 narrative; -1 exposition
[c]Coded +1 easy; +2 hard
[d]Coded +1 words from passages read; -1 words from passages not read